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Professional Development: The Need to Assess Yourself

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THE NEED TO ASSESS YOURSELF

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ABSTRACT: Effective science teaching is highly complex and demands sophisticated decision-making. Few administrators are in a position to understand the complexities and nuances of effective science teaching, and rarely are they able to provide the detailed feedback and ongoing support needed to help science teachers meet the vision set forth in science education reform documents. Thus, meaningful improvement in science teaching requires science teachers to accurately and continuously consider their own practice, thoroughly reflect on that practice, and implement strategies to move their practice forward. This article provides approaches useful for monitoring classroom teaching practices, self-assessing those practices, and strategies to improve practice. *This article promotes Iowa Teaching Standards 1 and 7.*

During my three-year term as *ISTJ* Editor, several of my editorials addressed the complex nature of effective science teaching and the crucial role of the teacher in science education reform (Clough, 2007a, b, c, & 2006). The complexities of effective science teaching require ongoing effort to improve practice. However, school administrators rarely possess the specific expertise necessary to understand and promote highly effective science teaching practices consistent with science education reform documents such as *Project 2061* (AAAS, 1989) and the *National Science Education Standards* (NRC, 1996). Moreover, busy administrators typically have time to visit each teacher in a school building only once or twice during a school year.

During my nearly twenty-five year teaching career, I have always sought to improve my practice. I often collect data on my teaching, analyze that data, and implement strategies to move my teaching more closely toward research-based teaching practices. While I look closely at how students perform in my class, such data alone does not help me understand what *I* am doing and what *I* need to change about my teaching practices. More important is an understanding of my decision-making and action in the classroom, and comparing that to what research makes clear is crucial for creating the most powerful learning environment for students. Focusing on teacher decisions and action rather than student outcomes may, at first, appear surprising. However, consider the medical profession. While doctors are very concerned for their patients and how they respond to treatment, a doctor's practice is assessed by how well their decision-making and actions reflect what medical research makes clear is the most appropriate course of treatment.

Science teachers should be proactive in assessing themselves on a continuous basis, working to move their practice towards what is well established regarding effective teaching, and helping administrators better understand their rationale for decisions and strategies. Doing so first requires an understanding of what makes for highly effective science teaching.

Highly Effective Science Teaching

What counts as highly effective science teaching is linked to desired ends. Table 1 lists commonly stated science education goals for students. These goals reflect the desired state put forward in science education reform documents, and they characterize a well educated individual who understands and acts on what they learn–a scientifically literate citizen.

Many goals in Table 1 are abstract and difficult to purposely plan instruction to achieve. More concrete descriptors of student activity that is congruent with the desired goals are helpful for understanding effective teaching and informing self-reflection. At least two very important insights emerge from articulating concrete student actions consistent with each goal. First, student actions for various science education goals have much in common, making apparent the interconnectedness of student goals. That is, a deep understanding of fundamental science concepts requires attention to other science education goals such as creativity, critical thinking, problem solving, communication skills, the nature of science and others that are often slighted. The overlap in student actions is also a blessing because promoting multiple goals does not require disparate pedagogical approaches. Second, a clear vision of congruent student actions makes more apparent what highly effective science teaching should promote.

TABLE 1

Common Science Education Goals for Students.

Students will:

1. Demonstrate deep robust understanding of fundamental science concepts rather than covering many insignificant or isolated facts.
2. Use critical thinking skills.
3. Convey an accurate understanding of the nature(s) of science.
4. Identify and solve problems effectively.
5. Use communication and cooperative skills effectively.
6. Actively participate in working towards solutions to local, national, and global problems.
7. Be creative and curious.
8. Set goals, make decisions, and self-evaluate.
9. Convey a positive attitude about science.
10. Access, retrieve, and use the existing body of scientific knowledge in the process of investigating phenomena.
11. Convey self-confidence and a positive self-image.
12. Demonstrate an awareness of the importance of science in many careers.

Just as important as knowing where you intend to take students is an understanding of where they are prior to and during instruction. Highly effective teaching continuously assesses learners to ensure that teacher practices are appropriately chosen based on student needs. Understanding the learner *and* having a clear vision of science education goals and congruent student actions are necessary for making effective decisions regarding:

- What content to teach
- What tasks and activities to implement
- What materials to use
- What teaching models and strategies to consider
- What teacher behaviors and interaction pattern to exhibit

Figure 1 provides a visual representation illustrating the basis of crucial teacher decisions for promoting desired science education goals. Understandably, attention immediately is drawn to the broad categories. However, of greater importance are the arrows conveying the importance of teacher decisions and their interactions. The overarching intent of the Decision-Making Framework is to illustrate that all teacher decisions regarding science content, tasks, activities, materials, models, strategies, and teacher behaviors should be made in light of desired goals for students and how students learn. In making key teacher decisions and their interactions explicit, the framework is useful for understanding effective science teaching and guiding self-reflection.

Selection of Science Content

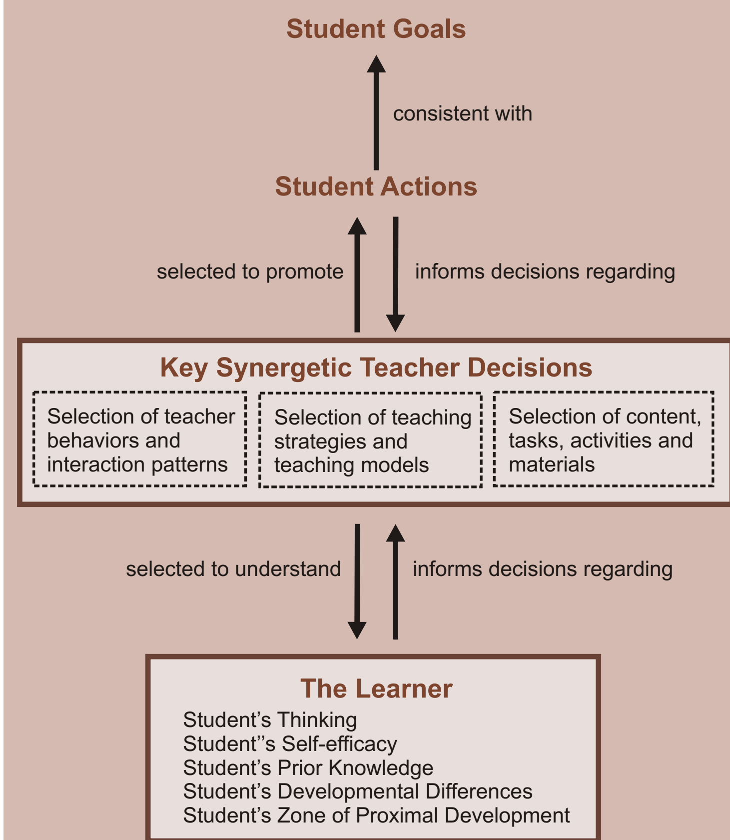
Decisions regarding content should be made in light of all student goals and the prior knowledge and experiences of learners. For students to engage in science content and develop a deep understanding of it, that content must be carefully chosen so that it is within their cognitive reach. Importantly, decisions regarding content cannot be based solely on what appears in adopted textbooks or district curricula. Even if all other aspects of a lesson are appropriately planned and implemented, instruction will not be effective is the content chosen is developmentally inappropriate.

Selection of Tasks and Activities

Highly engaging science tasks and activities require students to think and make decisions rather than simply follow directions. *ISTJ* is a rich source of activities that have students engaged in deciding how to solve problems, what data to collect, what data means, how to portray their results and conclusions, and other important decisions that demand mental engagement and promote all the student goals in Table 1.

Selection of Instructional Materials
Decisions regarding instructional materials are a key element in highly effective science teaching. Teachers should consider students' understanding of laboratory materials and devices as well as their understanding of the relevant science concepts. Even relatively simple materials can enhance or interfere with desired conceptual understanding. When a device is introduced prematurely, before students have made sense of the underlying science concepts, that device or tool may serve as a “black-box” that interferes with students' perceptions of what is happening and hinder their understanding of important scientific ideas. For example, after having used a bulb holder in a simple *batteries and bulbs* activity intended to illustrate electric circuits, a very bright student in an honors high school physics class thought the bulb holder was an essential part of the electric circuit (Annenberg/CPB, 1997).

FIGURE 1
Framework Illustrating Teacher Decisions and their Interactions (Clough *et al.*, In Press)



Selection of Teaching Models and Strategies
Teaching models that reflect how students learn and promote desired goals include, but are not limited to, the learning cycle, the 5-E model (Bybee, 1997), search, solve, create, and share (Pizzini et al., 1989), and the science writing heuristic (Keys et al., 1999). Teaching strategies like Predict-observe-explain (POE), think-pair-share (TPS), and the HRASE questioning strategy (Penick, Crow & Bonnstetter, 1996) should be chosen in concert with other teacher decisions for optimal impact on student learning.

Engaging Teacher Behaviors and Interaction Pattern
While interesting and developmentally appropriate content, tasks, and materials spark students' curiosity and set a stage for learning, what teachers do during those tasks is crucial. Effective teaching is a highly interactive activity, but several research-based teacher behaviors implemented in concert are needed to establish meaningful interactive environments to help students make desired connections. The questions teachers ask, the wait-time I & II they provide, the non-verbal behaviors they exhibit, and how they respond to students' ideas together have an enormous impact on the classroom environment, determining what students think, and helping students make desired connections.

Robust Self-Assessment to Move Practice Towards Highly Effective Science Teaching
Assessing all that is required for highly effective science teaching demands attention to details. While thinking about what transpired during a lesson after teaching is important, recalling all the important subtleties of teaching is simply not possible. A necessary and powerful strategy for better understanding what transpires in a lesson is to audio and/or video record a lesson, and then review the recording when time permits (consider how coaches video record games and break down tape afterwards!). Reviewing such recordings is always an informative and surprising experience. All teachers do particular things while teaching that they are unaware. Common surprises that teachers would like to improve upon, but are often not aware of, include:

- Primarily asking yes/no questions (e.g. questions beginning with “could”, “do”, “would”, etc.) rather than extended-answer questions;
- Primarily asking closed-answer recall questions rather than thought-provoking questions;
- Providing little wait-time I and wait-time II for students to think and provide additional ideas;
- Exhibiting passive non-verbal behaviors;
- Undesirable mannerisms (e.g. saying “OK” repeatedly as a filler);
- Remaining in only one part of the room;
- Exhibiting a monotone voice.

Reviewing videotape of teaching also sheds light on what students are doing during a lesson. Student actions congruent with the goals in Table 1 are observable events. No teacher wants students sitting passively throughout a lesson. When discrepancies between what a teacher wants to have occurring and what is observed are noted, teachers are in a position to make needed changes.

Becoming aware of what you do in the act of teaching has several benefits. First, simply knowing what you do causes change. That is, while in the act of teaching, recalling what you observed yourself doing on tape causes a change in teacher decision-making and behavior. Second, more purposeful professional development ensues as you reflect on your practice and create an action plan for improvement. Finally, understanding what you do well and what you want to improve permits you to direct your administrator when they visit your classroom. Make clear to them that you have audio and video recorded your teaching, and have analyzed it. Make clear what you do well and what you are working on improving. Guide your administrator to look at what you do well, and the strategies you are using to move your practice closer to highly effective science teaching. Also take this opportunity to help your administrator come to understand what highly effective science teaching looks like. During my career as a secondary school science teacher, my administrators were always surprised and impressed at my extensive self-reflection, data analysis, and personal efforts at professional growth. One even commented how it improved his understanding of effective science teaching and how it differs in certain ways from teaching in other disciplines.

Worth the Effort

While a great deal is to be gained from the kind of self-assessment described above, it does require time and effort. However, I often review recordings of myself on a weekend, holiday break, or during the summer months. Moreover, because all teachers exhibit patterns while teaching that are remarkably the same throughout a lesson and between lessons, you need only record yourself once a semester to begin your journey to highly effective teaching. And because all teachers have patterns, oftentimes observing 30 minutes of a lesson provides very accurate and meaningful information. Do, however, be sure to at some time watch how your class begins and ends. These complex and often hectic portions of the class are where much valuable instructional time is lost (Clough *et al*., 1994)

However you go about self-assessing your practice, the key is to do it! The first time is the most daunting. Some teachers find watching themselves teaching unnerving, but remember that no one has to see the recording except you. Over time you will grow accustomed and enjoy observing the complexity of teaching and the hard earned expertise you have developed and exhibit.

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